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# CRUSER • NEWS

Consortium for Robotics and Unmanned Systems Education and Research

## From Technical to Ethical...From Concept Generation to Experimentation

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## NWDC/CRUSER Sponsored Warfare Innovation Workshop

by Dr Raymond Buettner, NPS Faculty, CRUSER Director

Last month the annual Warfare Innovation Workshop (WIW), sponsored by the Naval Warfare Development Command (NWDC) and CRUSER, was held at the Naval Postgraduate School campus. This annual effort brings together NPS students, fleet officers, and industry experts for an intensive learning event that exposes the participants to methodologies associated with innovation while immersing them in a relevant naval context. The emphasis for this year's event, creating asymmetric warfighting advantages incorporating electromagnetic maneuver warfare, was developed in cooperation with the NWDC.

Six teams, composed junior officers and early career engineers, were given briefings on a range of topics including cross domain operations, Undersea Constellation, electromagnetic pulse, additive manufacturing, cyber warfare, agile EMCON and, of course, electromagnetic maneuver warfare. Along with the technical material NPS's Dr. Neal Thornberry provided the students with an Innovation Seminar and mentorship throughout the event. Captain (USN,Retired) Jeff Kline, the NPS Chair of Systems Engineering Analysis, provided the teams with a scenario to inspire creative approaches to real challenges that would face naval forces engaged in combat operations against a near peer competitor. Additionally each participant was provided with a rich assortment of preparation materials to explore both prior to and during the event.

Each team consisted of a facilitiator, 3-4 NPS students, 1-2 other naval officers and 3-4 early career engineers. NPS students and Fleet officers from DEVRON 5, NCWDG, C7F, N91 and NWDC were joined by engineers from Lockheed Martin, Draper Labs, Electric Boat, SSC Atlantic, NSWC Panama City, SPA Inc, NASA Ames, JHU APL, NSWC PSD, and Batelle. Five teams worked at the unclassified level and one team worked at the secret level. One team was composed entirely of the newly selected Chief of Naval Operations (CNO) Strategic Studies Group Associate Fellows. Five members of the CNO's Rapid Innovation Cell also participated as team members. All participants are eligible for continuing education units for their scholarly efforts during the workshop.

There has been much discussion of innovation by Senior Leaders, both in the Department of Defense and in the Department of the Navy. It is fitting that these relatively new workshops bring together participants from one of the oldest engines of innovation, the Naval Postgraduate School, the very mature CNO's Strategic Studies Group and the relatively new CRIC to explore innovation with some of the best and brightest young minds from the laboratories and industry.

To help keep things on track and to provide updates as to the latest and greatest in the world of technologies and capabilities were a variety of Senior Observers. These included representatives from the Deputy Undersecretary of the Navy's office, OPNAV N2/N6, OPNAV N91, NAVAIR, NWDC, NSWDC, the OSD Office of Net Assessment and even the Australian Navy. Each team had the task of defending their concepts to this group of experienced and knowledgeable experts and that no doubt helped to focus the effort.

After 3 days of hard work the teams had each developed dozens of potential concepts, but selected their top 3-4 concepts. These concepts were presented to the entire workshop for questions and comments. Unfortunately the event is conducted at the For Official Use Only level so we cannot share all of the great ideas with the general readership of this newsletter. However the official report will be issued soon and those with the appropriate access will be able to read the report. Also, we will be preparing a public releasable version of the concepts for broader dissemination later this month and will provide these in a future newsletter.

# Director's Corner

**Ray Buettner, CRUSER Director**

This has been another busy time for the CRUSER Community of Interest. Last month we wrapped up our annual Warfare Innovation Workshop which kicks off CRUSER's fifth innovation thread. This month NPS and CRUSER sponsored an international conference "The Future of Just War: Theoretical and Practical Challenges" (details next in next month's CRUSER news!)

## An Unmanned Future for Disaster Relief

by Jay McConville; jay.mcconville@lmco.com, www.lockheedmartin.com/unmanned

Recent natural disasters have reminded us that first response teams must operate in the most challenging, dangerous and remote environments. When responding, it is crucial to quickly deliver supplies and medical assistance with the most advanced systems available, as well as collect information and assess damage without endangering lives. As technology matures, first responders will be able to integrate unmanned aerial systems (UAS) as valuable resources in disaster relief.

UAS of many types offer a safe and capable response for disaster relief operations, including damage assessment, search and rescue, and delivering supplies to dangerous environments that result from conflict or natural disasters. Because many do not require runways, UAS can be deployed in minutes, in urban and rural areas. Additionally, for larger systems, operators can fly their aircraft from locations hundreds of miles from the disaster area. As an example, an operator could fly an aircraft in Houston, Texas, from a location in Austin, Texas. While smaller systems are operated from a closer range, they still remove pilots from immediate danger.

Just this year, following Cyclone Pam's devastation in Vanuatu, the World Bank and Vanuatu government sent a team of UAS and operators to aid in recovery efforts. The unmanned aircraft helped identify infrastructure damage and rapidly assessed affected areas where manned assets could not reach.

UAS capabilities encompass more than just video information. Recent demonstrations of the U.S. Marine Corps cargo-hauling unmanned K-MAX helicopter have proven its worth in firefighting because it can lift and drop thousands of pounds of water to extinguish flames. In the future, this system and others may also be able to extract at-risk individuals by unmanned air or ground vehicles, and quickly transport them to safety.

UAS can also work in the harshest conditions. In natural disasters such as wildfires, unmanned aircraft already work around the clock to locate the fire sources and direct firefighters where to focus resources. During a recent fire in Western Australia, a small Indago UAS helped operators identify the intensity and location of the fire source. The aircraft flew over the fire and located people and property at risk of damage, seeing through fire, smoke and dust. According to the Fire and Emergency Services Commissioner, the Indago helped to save about 100 homes.

For search and rescue operations, UAS offer a more efficient service that extends the reach of human and animal search groups. When equipped with an infrared camera that shows body heat, UAS can scan wrecked buildings, transportation accidents or collapsed mines to find survivors day and night. Current manned aircraft that are used to conduct aerial search and rescue operations cost time and money when both are critical. UAS can be deployed at a fraction of the cost of manned aircraft, and can often be airborne in less than five minutes upon arrival.

UAS offer a valuable tool to first responders, and this technology should be welcomed as a way to help protect our first responders. UAS have many uses today, and the future is bright.

*The unmanned K-MAX, helicopter successfully conducted a firefighting mission during a demonstration on Nov. 6. Aided by the small unmanned Indago quad rotor, unmanned K-MAX extinguished several fires while collecting and dropping more than 24,000 pounds of water onto the flames in one hour. (Photo Credit: Lockheed Martin)*

*The United National World Bank and the Vanuatu Government called upon Australian unmanned aerial system operator Heliwest, who deployed Lockheed Martin's Indago small unmanned aerial system (UAS) to conduct a rapid damage assessment after Cyclone Pam. (Photo by Heliwest)*

# Improving Robotic and Autonomous Systems Information Interoperability

by Steven W. Litwiller, Senior Planner, JS J6 DDC5I Data & Services Division, steven.w.litwiller.civ@mail.mil Brian S. Talicuran, IT Strategist, Booz Allen Hamilton, Inc, brian.s.talicuran2.ctr@mail.mil

## A NEED TO SHARE INFORMATION

Despite substantial increases in capability and applications, U.S. and multinational robotic and autonomous systems (RAS) have limited information sharing abilities in the operational environment. The requirement to increase these capabilities was cited in several key documents pertaining to unmanned systems capabilities, including: (1) Unmanned Systems Integrated Roadmap (FY2013-2038), [OUSD(AT&L)S&TS-UW&ISR]; and, (2) Open Business Model for Unmanned Aircraft Ground Control Systems, prepared by OSD AT&L, Unmanned Aircraft Systems Task Force, Interoperability IPT, November 6, 2013.

## A DATA-CENTRIC SOLUTION

Data must be properly managed before critical sensor or control information can be shared within or between unmanned systems. The Joint Staff is assisting in implementing a data-centric approach that enables improved information interoperability throughout different systems and across functional areas, to include air, maritime, and ground. The approach leverages two key elements: (1) Use of Extensible Markup Language (XML) as the common interface between different information systems, and, (2) Use of the National Information Exchange Model (NIEM) framework, which provides a consistent framework and process for building standardized data exchanges.

XML-based data exchanges perform their interchange function through the creation of a common schema that is tailored to the specific information sharing needs of the data sharing partners. NIEM is a community-driven, standards-based framework for exchanging information between different users, providing a consistent template to create data exchanges that can be extended to new participants and repeated for additional users. Details on NIEM procedures and methodology are available at https://www.niem.gov. The NIEM Military Operations Domain provides a Department of Defense (DOD)-focused venue for organizations and functional communities of interest to implement data exchanges.

## IMPLEMENTATION

A key advantage of XML-based data exchanges is that partners who need to share information do not have to change existing data stores or standards. The utility of XML for these data exchanges is determined by the system/program managers, and while some forms of data exchange will be more effective without an XML interface, the ubiquitous presence of XML-based data exchanges will create broader opportunities for improved information sharing.

NIEM uniquely supports data exchange needs between DOD and its mission partners. It is freely accessible and not constrained by export or proprietary restrictions. Industry and international militaries already use XML, which is expected to be the basis for information interoperability in future mission networks with Coalition partners. A 28 March 2013 DOD CIO memorandum states "DOD organizations shall first consider NIEM for their information sharing solutions when deciding which data exchange standards or specifications meet their mission and operational needs." Additionally, DOD Instruction 8320.07, 3 August 2015, affirms this guidance and specifies the consideration of NIEM whenever modernizing system information sharing capabilities. Transition to NIEM-conformant XML-based data exchanges is expected to occur incrementally throughout the DOD as systems, capabilities, and networks undergo modernization.

***This article is a summarized version of the full article, published in the September issue of Signal Magazine: http://www.afcea.org/content/?q=Article-robotics-and-autonomous-systems-need-information-interoperability***

## CRUSER Calendar

2-6 Nov - JIFX
16 Nov (1200 PST) - Monthly Meeting
16 Nov (1400 PST) - CRUSER Colloquium
5 Dec (1200 PST) - Monthly Meeting
details at http://CRUSER.nps.edu

**Short articles (up to 500 words) for CRUSER News are always welcome submit to: cruser@nps.edu**

# STUDENT CORNER

**Student: LT Christopher Machado, USN**

**Title:** An Analysis of Meteorological Measurements Using a Miniature Quad-Rotor Unmanned Aerial System

**Curriculum:** Meteorology and Physical Oceanography

**Link to Completed Thesis: https://calhoun.nps.edu/handle/10945/45892**

**Abstract:** Naval operational weather products, especially EM prediction, often fail to capture key meteorological features in the boundary layer due to the absence of high-resolution profile data. Quad-rotor sUAS with meteorological sensing capabilities may provide a solution for acquiring vertical profile data at sea. With the use of an RS92 radiosonde, InstantEye small Unmanned Aerial System (sUAS), and a calibrated sensing tower we analyzed the effects a quad-rotor had on the accuracy of temperature and pressure profiles in the surface layer. In unstable atmospheres temperature measurements made in the surface layer are as accurate as the manufacturers claimed accuracy. In stable atmospheres mixing occurs below 1.3 m, and above 2 m sampled air comes from as much as 2 m aloft. The InstantEye's rotors contribute to the variation in temperature measurement, and this effect is strongest near the surface. The variations introduced by the prop-wash helped suppress natural variations from turbulent fluctuations, but are still present above the surface layer. The InstantEye also introduces a 0.12 hPa pressure bias while in flight due to rotor-induced lift.

## New RPAS UAS Website and Forum

by Eric Hutchins, Creator/Administrator of site, ehutchins@argentechsolutions.com

RPAS UAS (Remotely Piloted Aircraft Systems / Unmanned Aircraft Systems) is a brand new website designed to educate people on the UAS industry. The site is primarily focused on the USA, but some information is applicable to other parts of the world. As experts in the field we are often asked the same questions time and time again. People commonly ask questions such as "How do I fly safely?" or "How do I fly legally?" Quite often we find ourselves providing the same basic information and pointing everyone to the same collection of laws and government websites. We realized that, to the common person, it was not always easy to parse through the wording of these laws, which is why we decided to make it easier for the enthusiasts using our own expertise. The expertise is primarily provided in the form of sponsorship by Peak 3 Technical Services and ArgenTech Solutions who manage a UAS test site and have over 200,000 hours of UAV operational experience respectively.

The basis of our website is to answer as many basic questions as possible. We cover many topics from how to fly legally, where you can fly legally, how you can fly safely, and more. Our aim is to focus not on only aspiring commercial operations but also information for hobbyists. We understand that there are many individuals out there with a growing interest to start flying, but are unsure of or are afraid of the complex laws and regulations. If someone was there to answer those questions and talk about their situations, more people would be able to get out there and start flying.

We soon realized that we would never be able to come up with every scenario or question that someone may have. To address this, we opened the RPAS UAS Forums. The RPAS UAS Forum is a place where people can come and ask their own questions and create their own discussions on all things RPAS and UAS. It is a completely free forum that is designed to be as friendly and open as possible. The forum uses open source modern technology that works well on all devices and sends notifications right away.

Our goal for the forums and website is to be transparent and community driven, and remain agnostic to any particular UAS or RPAS platform. Adding and updating information is something that needs to be done weekly (if not daily) with the current UAS world constantly changing and new regulations being published. To help provide up to date and correct information we have invited and will continue to invite experts from the field to join us and help educate the community. It is our mission to provide knowledge and experience to help the community grow and dispel any myths or misconceptions people might have.

Please feel free to come over and sign up, and join the conversation. We also maintain a Facebook page where we provide the most current news.

***http://www.rpasuas.com/***

## Librarian's Corner

Darrah, Mark. "The Age of Unmanned Systems" US Naval Institute Proceedings 141, no. 9 (September 2015): 22-27.

Unmanned Aircraft Systems (UAS): Commercial Outlook for a New Industry. CRS report http://www.fas.org/sgp/crs/misc/R44192.pdf

Fuller, Christopher J. "The Eagle Comes Home to Roost: The Historical Origins of the CIA's Lethal Drone Program." Intelligence and National Security 30, no. 6 (December 2015): 769-792.

The Ethics of Drone Strikes: Does Reducing the Cost of Conflict Encourage War? (Strategic Studies Institute) http://www.strategicstudiesinstitute.army.mil/pubs/display.cfm?pubID=1289